PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex Parte Harris

Appeal No. ________

Appellant:	Harris
Serial No.:	10/628,651
Filed:	July 28, 2003
Group Art Unit:	1793
Examiner:	Sikyin Ip
Title:	PHOSPHORUS-COPPER BASE BRAZING ALLOY
Attorney Ref. No.:	JWH-59US

Cincinnati, Ohio 45202 August 14, 2008

Commissioner for Patents and Trademarks
Box 1450
Alexandria, VA 22313-1450

BRIEF ON APPEAL

I. Real Party In Interest

The real party in interest in this appeal is J.W. Harris Co., Inc.., a corporation of Ohio having a place of business at 4501 Quality Place, Mason, Ohio 45040. J.W. Harris Co., Inc. is a wholly owned subsidiary of Lincoln Electric Holdings, Inc.

II. Related Appeals and Interferences

There are no related appeals or interferences known to Appellant, the Appellant's legal representative, or to the assignee which will directly affect or be directly affected by or have a bearing on the decision of the Board in the present appeal.

III. Status of Claims

Claims 1, 5-7, 22, 25 and 35-44 are currently pending and rejected, and are subject to this appeal. Claims 2-4, 8-21, 23-24 and 26-34 are cancelled. The prosecution history is as follows:

Claims 1-21 were originally filed upon filing of Application No. 10/628,651 on July 28, 2003. A Preliminary Amendment was filed July 26, 2004 amending claims 1, 2, 8, and 14 and adding claims 22-34. Claims 1-34 were rejected in the Final Office Action mailed on December 1, 2004. On May 31, 2005, Appellant filed a Response in which claim 6 was amended, claims 2-4, 8-21, 23-24 and 26-34 were cancelled, and new claims 35-42 were added, and a Request for Continued Examination and Request for 3-month Suspension of Action was filed. An erroneous Final Office Action was mailed on August 11, 2005, and vacated on August 18, 2005. On August 31, 2005, Appellant filed a Supplemental Response amending claim 37, and submitted Affidavits and Evidence. Claims 1, 5-7, 22, 25 and 35-42 were rejected in a Non-Final Office Action mailed on October 25, 2005. Appellant filed a Response on February 27, 2006 amending no claims but submitting further Affidavits and Evidence. Claims 1, 5-7, 22, 25 and 35-42 were rejected in a Final Office Action mailed on May 18, 2006. Appellant filed a Notice of Appeal and a Response adding new claims 43-44 and submitting further Affidavits and Evidence on August 18, 2006. Claims 1, 5-7, 22, 25 and 35-42 were rejected and claims 43-44 were not entered in an Advisory Action mailed on September 15, 2006. Appellant filed a Request for Continued Examination on October 17, 2006 to enter the previously-filed amendment, Affidavit and Evidence. Claims 1, 5-7, 22, 25 and 35-44 were rejected in a Non-Final Office Action mailed June 28, 2007. Appellant filed a Response amending no claims on December 27, 2007.

Claims 1, 5-7, 22, 25 and 35-44 were rejected in a Final Office Action mailed April 8, 2008. Appellant filed a Notice of Appeal and Pre-Appeal Brief Request for Review on July 8, 2008. The Panel issued a Decision to Proceed to the Board on August 11, 2008, maintaining the status of Claims 1, 5-7, 22, 25 and 35-44 as rejected.

IV. Status of Amendments

There are no amendments pending.

V. Summary of Claimed Subject Matter

Claims 1, 22, 35, and 39 are independent claims. The pending claims find support in the present application and/or in the parent Application No. 10/226,672, which was incorporated by reference at p. 1, lines 1-6 (hereinafter "'672 appln").

Claim 1:

Claim 1 is generally supported, for example, at p. 4, line 17 to page 5, line 8 in the Summary of the Invention; p. 8, line 12 to p. 9, line 15 of the Detailed Description; and originally-filed claims 1 and 2. Examples in The Table on p. 14 that fall within the scope of claim 1 include Alloys 4-10, and FIG. 1 provides corrosion resistance results for Alloy 4 and alloys similar to Alloys 6-8 (varied Si content) compared to commercially available silver phos-copper alloys, as described at p. 16, line 3 to p. 17, line 7. More specific reference to the specification, element-by-element, is provided as follows:

A solid brazing component {e.g., p. 4, line 17 to p. 5, line 2; p. 8, line 12} having a liquidus temperature above 840°F {e.g., p. 5, line 3; p. 8, line 13} selected from the group consisting of wire, strip, foil and performs {e.g., p. 5, line 1; p. 8, lines 12-13}, wherein the brazing component is made of an alloy consisting essentially of {e.g., p. 5, lines 3-4; p. 8, lines 14-15; p. 9, lines 12-15}, in weight percent {p. 8, line 15}:

(a) about 4-9% phosphorus; {e.g., p. 5, line 4; p. 8, line 15}

(b) about 0.1-10% tin; {e.g., p. 5, line 4; p. 8, lines 15-16}

(c) about 0.1-15% nickel; {e.g., p. 5, lines 4-5; p. 8, lines 16 and 21-25}

(d) about 0.1-18% silver; {e.g., p. 5, line 5; original claim 2; p. 8, lines 20-22 of '672 appln}

(e) up to about 3% silicon; {e.g., p. 5, line 5; p. 9, lines 3-4}

(f) up to about 4% antimony; {e.g., p. 5, lines 5-6; p. 8, lines 17-20}

(g) up to about 3% manganese; and {e.g., p. 5, line 6; p. 9, lines 8-9}

the balance copper. {e.g., p. 5, line 6; p. 8, lines 16-17}.

Claim 22:

Claim 22 differs from Claim 1 in that silver (d) is optional ("up to about 18%"), and silicon (e) is required ("about 0.001-3%"). Claim 22 is generally supported, for example, at p. 4, line 17 to page 5, line 8 in the Summary of the Invention; p. 8, line 12 to p. 9, line 15 of the Detailed Description; and originally-filed claim 1. Examples in The Table on p. 14 that fall within the scope of claim 22 include Alloys 4 and 6-11, and FIG. 1 provides corrosion resistance results for Alloy 4 and alloys similar to Alloys 6-8 (varied Si content) compared to commercially available silver phos-copper alloys, as described at p. 16, line 3 to p. 17, line 7. More specific reference to the specification, element-by-element, is provided as follows:

A solid brazing component {e.g., p. 4, line 17 to p. 5, line 2; p. 8, line 12} having a liquidus temperature above 840°F {e.g., p. 5, line 3; p. 8, line 13} selected from the group consisting of wire, strip, foil and performs {e.g., p. 5, line 1; p. 8, lines 12-13}, wherein the brazing component is made of an alloy consisting essentially of {e.g., p. 5, lines 3-4; p. 8, lines 14-15; p. 9, lines 12-15}, in weight percent {p. 8, line 15}:

(a) about 4-9% phosphorus; {e.g., p. 5, line 4; p. 8, line 15}

(b) about 0.1-10% tin; {e.g., p. 5, line 4; p. 8, lines 15-16}

(c) about 0.1-15% nickel; {e.g., p. 5, lines 4-5; p. 8, lines 16 and 21-25}

(d) up to about 18% silver; {e.g., p. 5, line 5; p. 9, lines 5-6}

(e) about 0.001-3% silicon; {e.g., p. 5, line 5; p. 9, lines 3-4}

(f) up to about 4% antimony; {e.g., p. 5, lines 5-6; p. 8, lines 17-20}

(g) up to about 3% manganese; and{e.g., p. 5, line 6; p. 9, lines 8-9}

the balance copper. {e.g., p. 5, line 6; p. 8, lines 16-17}

Claim 35:

Claim 35 includes the same optional and required ranges for silver (e) and silicon (c) as claim 22 and thus differs from Claim 1 in the same manner as Claim 22 with respect to those 2 elements. Claim 35 further differs from Claims 1 and 22 with respect to the upper ranges of phosphorus (a) and tin (b), and nickel (d) is an optional element ("up to about 3%) instead of required. Finally, Claim 35 includes a proviso that "the sum of tin and antimony does not exceed about 10%." Claim 35 is generally supported, for example, at p. 4, line 21 to page 5, line 2 of '672 appln; p. 8, line 10 to p. 9, line 5 of '672 appln; and original claim 1 in the '672 appln (and by the present specification at page 5, as amended in page 2 of Appellant's submission dated August 31, 2005). Examples in Tables 1 and 2 on pp. 14 and 17 of the '672 appln that fall within the scope of claim 35 include Alloys 2-11, 13 and 15-17. More specific reference to the specification, element-by-element, is provided as follows:

A solid brazing component {e.g., p. 4, line 17 to p. 5, line 2; p. 8, line 12; p. 4, lines 12-21 of '672 appln; p. 8, line 10 of '672 appln;} having a liquidus temperature above 840°F {e.g., p. 5, line 3; p. 8, line 13; p. 4, lines 21-22; p. 8, lines 11-12 of '672 appln} selected from the group consisting of wire, strip, foil and performs {e.g., p. 5, line 1; p. 8, lines 12-13; p. 4, line 21 of '672 appln; p. 8, lines 10-11 of '672 appln}, wherein the brazing component is made of an alloy consisting essentially of {e.g., p. 5, lines 3-4; p. 8, lines 14-15; p. 9, lines 12-15; p. 4, lines 21-22

of '672 appln; p. 8, lines 12-13 of '672 appln}, in weight percent {p. 8, line 15; p. 8, line 13 of '672 appln}:

(a) about 4-10% phosphorus; {p. 4, lines 22-23 of '672 appln; p. 8, line 13 of '672 appln}

(b) about 0.1-8% tin; {p. 4, line 23 of '672 appln; p. 8, lines 13-14 of '672 appln}

(c) about 0.001-3% silicon; {p. 4, line 23 of '672 appln; p. 8, line 14 of '672 appln}

(d) up to about 3% nickel; {p. 4, line 24 of '672 appln; p. 8, lines 19-20 of '672 appln}

(e) up to about 18% silver; {p. 4, lines 23-24 of '672 appln; p. 8, lines 21-22 of '672 appln}

(f) up to about 4% antimony; {p. 4, line 24 of '672 appln; p. 8, lines 15-17 of '672 appln}

(g) up to about 3% manganese; and {p. 4, line 24 to p. 5, line 1 of '672 appln; p. 8, lines 24-25 of '672 appln}

the balance copper, {p. 5, line 1 of '672 appln; p. 8, lines 14-15 of '672 appln}

with the proviso that the sum of tin and antimony does not exceed about 10%. {p. 8, line 18 of '672 appln; p. 13, lines 11-18 of '672 appln}

Claim 39:

Claim 39 differs from Claim 35 in that the "solid brazing component" is recited to be a "fluxless solid brazing component." All other elements are identical, and thus the claim elements and all references to the specification are as recited above for claim 35. Further, the "fluxless" feature is referred to in the specification at p. 19, lines 4-9 of the '672 appln. In the present specification, at p. 11, lines 6-13, the method of using the component is described in which flux is used "if necessary", i.e., it is optional and therefore the component may be used without flux and thus may be fluxless.

VI. <u>Grounds of Rejection to be Reviewed on Appeal</u>

A. Whether Claims 1, 5-7, 22, 25 and 35-44 are unpatentable under 35 U.S.C. §103(a) over PL 149319 (hereinafter "the PL Abstract") in view of CN 1060052 (hereinafter "the CN Abstract").

B. Whether Claims 39-42 are unpatentable under 35 U.S.C. §103(a) over the PL Abstract and further in view of Yurasko U.S. Patent No. 3,428,442 (hereinafter "Yurasko") or Joseph U.S. Patent No. 3,674,471 (hereinafter "Joseph").

C. Whether Claims 35-42 are unpatentable under 35 U.S.C. §103(a) over EP 465861 (hereinafter "EP '861") in view of the CN Abstract.

D. Whether Claims 22, 25, 35-42 and 44 are unpatentable under U.S.C. §103(a) over SU 1706816 (hereinafter "the SU Abstract") or Yurasko in view of the CN Abstract.

E. Whether Claims 22, 25, 35-38 and 44 are unpatentable under U.S.C. §103(a) over the CN Abstract.

F. Whether Claims 1, 5, 22 and 43 are unpatentable under U.S.C. §103(a) over Joseph.

VII. Argument

A. Claims 1, 5-7, 22, 25 and 35-44 over the PL Abstract in view of the CN Abstract

(1) Claims 1 and 5-7

It is the Examiner's position that the PL Abstract discloses the features including the claimed solid brazing components by virtue of disclosing a Cu alloy powder intermediate product, and that the difference between the claimed invention and the PL Abstract are that the PL Abstract does not disclose the forms of the brazing component, nor the Mn content or liquidus, solidus and thermal arrest temperatures. {4/8/08 Final Office Action, p. 2} It is further the Examiners position that Mn is an optional element and can thus be eliminated and that the temperatures are inherent in the material disclosed by the PL Abstract. {Id. at pp. 2-3} Finally, it is Examiners position that the CN Abstract discloses that a brazing solder component could be formed into rods, ingots, strips, or powder, such that it's within ambit of ordinary skilled artisan "to form the brazing component into form suitable for the brazing application such as a rod without paste and carrier." {Id. at p. 3}

Appellant disagrees that the PL Abstract teaches or suggests the presently claimed invention, alone or in combination with the CN Abstract. In *KSR*, the Supreme Court noted that

an invention may be obvious "[w]hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp." *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1742 (2007). As explained in *Eisai Co. Ltd. v. Dr. Reddy's Labs. Ltd*, "First, *KSR* assumes a starting reference point or points in the art, prior to the time of invention, from which a skilled artisan might identify a problem and pursue potential solutions. Second, *KSR* presupposes that the record up to the time of invention would give some reasons, available within the knowledge of one of skill in the art, to make particular modifications to achieve the claimed compound. ... Third, the Supreme Court's analysis in KSR presumes that the record before the time of invention would supply some reasons for narrowing the prior art universe to a 'finite number of identified, predictable solutions'." 533 F.3d 1353, 1359 (Fed. Cir. 2008)(citing *KSR*, 127 S. Ct. at 1742; *Takeda Chem. Indus., Ltd. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350 (Fed. Cir. 2007)). Further, "[t]o the extent an art is unpredictable, as the chemical arts often are, KSR's focus on these 'identified, predictable solutions' may present a difficult hurdle because potential solutions are less likely to be genuinely predictable." *Id.* In the present application, and with the PL Abstract as the starting reference point, there cannot be said to exist a finite number of identified, predictable solutions to which the prior art suggested the universe be limited nor to which a skilled artisan would have been led to achieve based on the knowledge at the time the invention was made. As in *Eisai*, there is not present a finite (and small in the context of the art) number of alloy options easily traversed to show obviousness. One skilled in the art would have to have some reason to select the particular combinations of alloys from the large number of options presented by the PL Abstract, and to have a reasonable expectation that such combinations would produce the desired result. In finding obviousness, Examiner has simply retraced the path of the inventor with hindsight, discounted the number and complexity of the alternatives, and ignored the synergy with which the elements of the alloy operate. Brazing alloy compositions of multiple elements as claimed present an unpredictability in results, and the synergy with which the elements interact contributes to that unpredictability, such that a finite number of options is not present, and there is no reasonable expectation of success in view of the PL Abstract to select from the myriad of possible options presented therein. These factors apply against a finding of obviousness. Moreover, the combination with the CN Abstract does nothing to lead one skilled in the art down the path of success. Solders are not the same as brazing alloys

and the formability of the two are not the same, with brazing alloys being known to those of skill in the art to be more brittle and more difficult to form into solid forms while solders are malleable and easily formed. Each component of an alloy affects its physical properties, and it cannot be assumed that all possible alloy compositions with the PL Abstract can be formed into the claimed solid forms simply because a reference to a solder alloy claims that solders can be so formed. Again, there is no reasonable expectation of success for a finite number of alloys. Examiner has failed to establish a *prima facie* case of obviousness, such that Examiner's rejection should be overturned.

To more specifically address the facts at issue, the PL Abstract discloses a Brazing Paste that combines a Cu Alloy Powder with a Carrier, the combination of which is asserted to permit brazing below 973K (1292°F) to prevent embrittlement of the brazed contacts. Only a single example is provided within the Abstract, and which is characterized as a "typical paste." In Appellants previous submissions, that Example is referred to as "Alloy A." Alloy A, as set forth in the PL Abstract, was tested and no braze could be formed at brazing temperatures below 973K. The temperature was raised above 973K and the Brazing Paste did not begin to melt and flow until well above 1500°F (See First Affidavit of Robert Henson). Examiner states that Appellants argument (quoted on page 7 of the 04/08/2008 Office Action) is "inconsistent with Table A submitted by applicant that Alloy A has liquidus temperature at 1284°F." To the contrary, Alloy A "did not begin to melt <u>and flow</u> until well above 1500°F." (emphasis added). Liquidus is a term for where the alloy is completely melted, but it is not a descriptive term for "flow." An alloy can melt, but not flow, in which case no braze is formed. Appellant, as well as any skilled worker, would be concerned not only with the melting of the alloy but its ability to flow into the joint, for there will be no viable braze if the alloy does not flow under capillary action into the joint. Turning to the photographs provided in the Third Affidavit of Robert Henson (filed 2/27/06), it is seen that cohesive forces formed the melted alloy A into balls, preventing flow into the joint. In other words, the surface tension was high such that the alloy did not wet the surface. Thus, while the alloy eventually melted, it did not flow and therefore, as asserted, did not form a braze at the temperature asserted by the PL Abstract or even at temperatures well above that.

Alloy B was also tested, its composition being varied from Alloy A by lowering the Sn content to within the claimed range and increasing the P content to 1%, which is still

below the claimed range. Still, no braze could be formed. Alloy C-1 was tested, which increased the P content from that of Alloy B to 3%, which is just below the lower limit in the claimed range, and a commercial flux was added, and still a commercially viable braze could not be formed. Finally, Alloy E was tested, which raised the P content to a value within the claimed range, but the Sn content was lowered in favor of a higher Sb content that is above the claimed range. A commercial flux was again added, and still a commercially viable braze could not be formed due to significant black oxide formation.

Appellant attempted several powder compositions within the broad teachings of the PL Abstract, and pastes containing those powder compositions could not be used to form commercially viable brazes at brazing temperatures below 973K, which is the temperature range that the PL Abstract cites that the paste permits brazing. More notably, Appellant tested the only specific compositional example provided, and no braze could be formed. Appellant further made adaptations in an attempt to obtain the desired results, and still could not obtain a commercially viable braze. The powder composition in combination with the carrier cannot produce brazes as asserted in the PL Abstract at temperatures below 973K, as the evidence has shown. Even adding a commercial flux, as one skilled in the art would try to do if attempting to make the teachings operable, did not work—a commercially viable braze still could not be formed. Raising the temperature, as one skilled in the art would try to do if attempting to make the teachings operable, resulted in damage to the copper parts being brazed, which also prevents the teachings of the Abstract from being commercially operable or viable.

Referring specifically to the evidence, as set forth in the Third Affidavit of Robert Henson (filed 2/27/06) and the accompanying Response, as one skilled in the art, Mr. Henson attempted to practice the teachings of the PL Abstract. As set forth in great detail, Mr. Henson followed the Example provided therein and could not obtain a braze. Having failed to obtain the desired results, Mr. Henson then made certain experiments and adaptations, within the skill of the competent worker, in an effort to achieve a braze. He tried brazing the powder form. He altered the composition while staying within the broad teachings of the PL Abstract. None of the adaptations resulted in a viable braze. Only the addition of a commercial flux caused any flow of the brazing alloy into the joint, but it is contrary to the teachings to use a commercial flux when a carrier is present. If the PL Abstract is prior art for all it teaches, it teaches nothing to the skilled worker that would allow the skilled worker to achieve a viable braze. Thus, persons skilled in

the art, having the teachings of the PL Abstract before them, have no reasonable expectation of success in selecting alloy combinations from the PL Abstract, particularly where the one example provided therein fails to succeed. Such evidence warrants against a finding of *prima facie* obviousness.

On page 7 of the 04/08/2008 Office Action, third paragraph, Examiner responds to Appellants arguments on alloys B-E by claiming that Appellant has not provided evidence that the claimed alloy has a liquidus T less than 1410°F from end-point to end-point. Examiner then reiterates his comments set forth on pages 7-9 of the 05/18/2006 Office Action. First, the element of a <1410°F liquidus T appears in dependent claim 5, and is thus a narrowing element to the broader claim 1. It is therefore not clear why the Examiner makes this comment. In the 12/17/2007 Response, pages 10-11 pertaining to claim 5, Appellant provides an explanation that the evidence provided shows the affect of compositional variation on the temperature profile of the alloy. Appellant has enabled one skilled in the art to select the compositional elements to achieve the claimed temperature profile, while the PL Abstract provides no such teaching or suggestion. It is not asserted that all possible compositional variations from end-point to end-point will have the claim 5 temperature profile, rather it is claimed in claim 5 that the composition should be configure to have it, i.e., the amounts should be selected to achieve it, and it is within the skills of the ordinary worker to ascertain whether the claimed temperature profile is achieved in view of the specification and without undue experimentation. Examiners comment is thus nonsensical and irrelevant to the patentability of claims 1 and 5.

Second, in the Response of 08/18/2006 (entered with 10/17/2006 RCE) (pages 7-8) together with the Affidavit presented therewith (Fourth Affidavit of Robert Henson), Appellant addressed the comments of Examiner made in pages 7-9 of the 05/18/2006 Office Action, and yet Examiner reverts back to those comments without regard to Appellant's subsequent response. In Appellant's response, it was explained that the fourth affidavit from Robert Henson addresses points raised by Examiner in the final Office Action dated May 18, 2006, and that the record of the instant application contains numerous test alloys and an oversimplification was made in the attempt to explain the voluminous data such that the Fourth Affidavit was submitted to clarify prior statements (or partial misstatements). While Alloy F has Sn content within the scope of claim 1, and Sb content within the scope of claim 1, the alloy is not considered to be ideal due to the fact that the combined Sn and Sb content exceeds 10%.

Alloys I, J, and K admittedly do not fall within the scope of claim 1, but numerous alloys of the present invention are provided in that Table A that do fall within the scope of claim 1. In addition, Alloys I, J, and K as well as numerous other alloys in Table A do fall with the scope of claims 35 and 39, to be discussed below. The purpose of Alloys I and J was to test the alloy near the endpoints of the claimed ranges for P and Sn, without regard to the presence of Ag (which is required in Claim 1 but optional in claims 35 and 39) to show the criticality of the ranges for those two elements. The presence or lack of presence of Ag does not affect that criticality. The purpose of Alloy K was to provide an exemplary embodiment of the invention of claims 35 and 39, without Ag. In its totality, the evidence that has been provided serves to demonstrate the effect of varying certain elements relative to others. This evidence, considered as a whole, rather than fixating on one or a few particular alloys, demonstrate criticality of the various narrow ranges claimed in claim 1, as well as in claims 22, 35 and 39 to be discussed separately below.

Based upon the evidence presented, it is asserted that Appellant has established by a preponderance of the evidence that the PL Abstract is inoperable for what it purports to teach, and further, that the PL Abstract in combination with the CN Abstract do not present a finite and small, easily traversed number of options that would be obvious to the skilled artisan. Rather, one skilled in the art is taught nothing from the PL Abstract that would guide them toward producing a commercially viable copper alloy solid brazing component. At best, if one laid out all the possible combinations of alloys in the broad ranges disclosed in the PL Abstract, one could throw a dart and hope to land on a point that produces an operable composition that could be formed into a claimed solid component and that could form a commercially viable braze. The mere chance that one might get lucky and stumble upon an operable teaching should not satisfy the requirement that the reference teach or suggest the claimed invention, and certainly does not provide the skilled artisan with a finite and small, easily traversed number of options for which they may have a reasonable expectation of success. The only attempt at specific guidance toward selecting a working alloy composition, i.e., the specific example, provided in the PL Abstract has been shown to be inoperable for its intended purpose. Even if presumed that a skilled worker would make certain experiments and adaptations if they do not immediately obtain desired results, i.e., add a flux or increase the temperature, Appellant has shown that such adaptations were made and still were unsuccessful. Simply put, the PL Abstract does not enable one skilled in the art to make and use the claimed invention, nor provide the skilled artisan with a

finite and small, easily traversed number of options for which they may have a reasonable expectation of success, and therefore does not render the claimed invention obvious.

In addition to the above assertion that the PL Abstract does not teach or suggest the claimed invention, Appellant has gone further and produced significant evidence of criticality of the claimed ranges and synergy of the elements. The claims of the present invention provide a narrow range of compositions that can be formed into a solid component, which form and composition can then be used to produce commercially viable brazes. No carrier is used or need, and flux, in many instances, is not needed. To achieve this commercial viability, recognition of the limits of each component of the composition and their interaction together must be understood, which understanding cannot even begin to be gleaned from the PL Abstract. The PL Abstract is so broad as to encompass a large number of inoperable embodiments, the only specific example provided therein is inoperable, and one skilled in the art cannot ascertain from the teachings of the PL Abstract or obvious modifications that are within their skill how to arrive at an operable embodiment let alone the claimed invention. The PL Abstract presents an extremely large number of possibilities, the results of which are unpredictable, and gives no guidance on the relationship between the elements nor the relative amounts thereof, that would allow one skilled in the art to easily traverse the options to select the combinations that would produce a solid brazing component capable of achieving a commercially viable braze in accordance with the claimed invention.

Claim 1 is directed to solid brazing components that are made of an alloy consisting essentially of the specified alloy constituents in the specified ranges. The specification and evidence submitted during the course of prosecution includes numerous examples of alloys of the present invention and their properties and benefits that support the non-obviousness of the claimed invention. Specifically, referring to previously submitted Table A (which includes the Examples from The Table in the present specification and Tables 1 and 2 in the '672 appln specification, as well as additional testing data conducted post-filing), the following Examples fall within the scope of claim 1: Alloys F, 4A, 5A, 6A, 7A, 8A, 9A, 10A, 10B, 11B, 13B, 15B, 16B and 17B. Of these 14 examples, only 1 example, Alloy F, was considered to be inoperable for producing a commercially viable braze. The reason for the failure of Alloy F was that, despite compliance with the ranges recited in claim 1, the combined Sn and Sb content exceeds 10%, which is taught in the specification to be a factor in achieving

an operable solid brazing component. Thus, one skilled in the art, guided by the specification, would be led to exclude Alloy F from the scope of the claim. The remaining 13 examples were all capable of being formed into the claimed solid components, and all demonstrated good temperature profiles for brazing, including a low solidus temperature and small range between the solidus temperature and the major thermal arrest and/or liquidus temperature. For the test samples falling within the scope of claim 1, the range of P was from 5-7; the range of Sn was from 2-8; the range of Ni was from 0.1-8; the range of Ag was from 2-18; the range of Si was from 0-0.5; the range of Sb was from 0-3; and the combined Sn/Sb content ranged from 2-11. Thus, operable examples were given throughout the ranges of each component.

To show criticality for the P content of 4-9%, Alloys B, C-1, and H-1 were provided with all components within the claim range except P content just below (1%, 3%) and just above (11%) the claimed range, respectively. As stated in the second affidavit of Robert Henson for Alloy B:

> *While the alloy was extruded into rod for experimental purposes, based upon my experience, it would not be practical to extrude this alloy on a commercial basis due to a very slow run speed (well below commercial BCuP alloys) and the high potential for hot shorting. The alloy has a very wide brazing temperature range (1045°F-1669°F), no major thermal arrest, and very high liquidus temperature. Therefore, the brazing temperature for this alloy is prohibitively high, being at or near 1669°F. In addition, because of the low phosphorus content, this alloy is not considered a BCuP alloy, and brazing cannot be accomplished without the use of a flux. The alloy had poor flow, did not melt completely (the alloy liquated, meaning that it separated, with some constituents melting and others remaining solid), and required repeated additions to fill the joints. This alloy would not be suitable for commercial brazing in wire or rod form.*

As stated in the second affidavit of Robert Henson for Alloy C-1:

> *The liquidus temperature is still high for this alloy, although the increase in phosphorus [relative to Alloy B] did lower that temperature, and a major thermal arrest is observed. This alloy was hard to extrude, and based upon my experience, it would not be practical to extrude this alloy on a commercial basis due to the very slow run speed (well below commercial BCuP alloys) and high potential for hot shorting. An improvement in the ability to flow was observed, but the amount of heat required to fill the joint and form a cap is still prohibitive.*

As stated in the second affidavit of Robert Henson for Alloy H-1:

> *The alloy could not be extruded into rod or wire form. Lowering the tin and antimony content did not help--the high phosphorus content proved to be disastrous. The alloy had an even higher liquidus and the solidus only appeared to be identified. Alloy*

has a very wide brazing temperature range (1069°F-1620°F), and no major thermal arrest. Therefore, the brazing temperature for this alloy is prohibitively high, being at or near 1620°F.Braze tests using a solid braze component could not be performed.

Thus, testing outside the claimed range for the P component shows criticality. The claimed invention is specifically directed to alloys that can be classified as BCuP alloys by the American Welding Society, and that can be formed into the recited solid brazing components (of which a powder is not included). Such alloys require minimum phosphorus content and a maximum phosphorus content, neither of which is taught or suggested by the PL Abstract. At 1% phosphorus, the brazing temperature was prohibitively high for brazing copper components. Increasing to 3% from 1% showed an improvement in the temperature profile, but the content was still a bit too low to enable forming the alloy into a claimed solid component. At the claimed range of 4-9%, the brazing temperature profile is suitable for the intended purpose and the alloys can be formed into the recited solid components. Above 9%, specifically at 11%, the brazing temperature again becomes unsuitable for brazing copper parts and the claimed solid component could not be formed. There is no teaching or suggestion in the PL Abstract of the claimed range of 4-9%, and the range has been shown by the evidence to be critical for forming the claimed solid brazing components and for brazing copper parts.

To show criticality for the upper limit of the Sn content of 10%, alloy D-1 was provided with all components within the claim range except Sn content just above (11%) the claimed range. As stated in the second affidavit of Robert Henson for Alloy B:

Good temperature profile, but the alloy was hard to extrude, and based upon my experience, it would not be practical to extrude this alloy on a commercial basis due to the slow run speed (well below commercial BCuP alloys) and high potential for hot shorting. In addition, the wire was extremely brittle, and could not be wrapped onto a reel. During the braze tests, the alloy flowed too quickly, such that gaps could not be filled and voids were left in the brazed joints of the tube and return bend. These brazed parts would be scrapped upon visual inspection. In addition, the braze cracked in the bend test, such that if the parts were not scrapped, there is a high likelihood of failure in service. Thus this alloy is not a reliable braze material.

Since Sb can be substituted for all or some of the Sn, up to 4%, as disclosed in the specification, to show criticality for the upper limit of the Sn + Sb content of 10% and the upper limit of Sb of 4%, alloys E and F were also provided with all components within the claim range except Sb

content and Sn + Sb content just above (5%, 11%) the claimed range, respectively. As stated in the second affidavit of Robert Henson for Alloy E:

> *Good temperature profile, but the alloy was hard to extrude, and based upon my experience, it would not be practical to extrude this alloy on a commercial basis due to the very slow run speed (well below commercial BCuP alloys) and high potential for hot shorting. During the braze tests, the alloy flowed too quickly, such that gaps could not be easily filled and a raised cap did not form. Thus, this alloy is not a reliable braze material.*

As stated in the second affidavit of Robert Henson for Alloy F:

> *OK temperature profile, but alloy could not be extruded into wire or rod form. The extruder was repeatedly plugged by the material and hot shorting was extreme. Dross was observed, which is unacceptable for a commercial brazing alloy, and the braze cracked in the bend test, such that there is a high likelihood of failure in service. Thus, this alloy is not a reliable braze material.*

These tests demonstrate the criticality of the upper limits of Sn alone, Sb alone, and Sn combined with Sb for purposes of forming the claimed alloys into the claimed solid brazing components. The PL Abstract discloses a powder form, and does not teach or suggest the criticality of the Sn content when using the alloy composition in a solid component form for brazing copper parts.

To further establish criticality of the P, Sn and Sb contents, Alloy G was also provided with a P content that just exceeded the claimed P content (11%), a Sb content that just exceeded the claimed Sb content (5%), and a Sn content within the claimed Sn content (9%) but a combined Sn + Sb content that exceeds the 10% limit disclosed in the specification that should be followed when substituting Sb for a portion of the Sn. As stated in the second affidavit of Robert Henson for Alloy G:

> *The alloy could not be extruded into rod or wire form. The high phosphorus, tin and antimony contents proved to be disastrous. The alloy had a very high liquidus and the solidus could not be identified. Braze tests using a solid braze component could not be performed.*

Thus, each of phosphorus content, Sn content, Sb content, and the total combined Sn and Sb content are critical for the claimed invention, to produce a BCuP alloy having temperature profile that is suitable for brazing copper parts and for forming the alloy into a claimed solid brazing component.

As set forth in the Second Affidavit of Mr. Robert Henson, in addition to the importance of the brazing temperature, the composition must also be selected to provide a ductile

alloy, one that is capable of being formed into a solid brazing component, and one that forms a braze that does not crack and fail in service. To be extrudable into wire or rod form, the alloy must have good flow and temperature properties to avoid hot shorts and to provide a run speed suitable for cost-effective commercial production. In addition, during brazing, the solid alloy component must not experience any significant liquation, poor flow, or poor capping ability that would limit or negate its suitability for use in forming reliable and visually-inspectable braze joints.

Examiner cites the CN Abstract for the purpose of teaching that it is known to form brazing components into a suitable form for the brazing application without a carrier. As repeatedly asserted, the CN Abstract is directed to a solder composition, not a brazing composition. While the recited solid forms may be conventional for solder compositions, solder compositions are different than brazing compositions. It is well known that solder alloys are more malleable than braze alloys, such that solders are more easily formed into solid shapes. While both solders and brazing alloys are in the same field of endeavor to the extent they are both useful for joining metals, the differences between solders and brazing alloys are germane to the invention. Brazing alloys and solders are designed to operate in different temperature ranges, and have different elements and properties that affect the operating temperature and the formability of the alloys. Thus, solders are directed to a different class of materials within the field of metal-joining compositions. Moreover, the additional elements in the solder alloy are precluded by the transitional phrase "consisting essentially of" as recited in claim 1, which transitional phrase is specifically used because in alloy compositions such as those claimed, additional elements can have a marked effect on the properties of the material, such as malleability/formability. The present invention focuses, on the one hand, on alloys that maintain the operating temperature for a brazing alloy, but on the other hand, provide more formability than other braze alloys. Solders do not have the same problem as brazing alloys with formability–they are generally malleable. The very difference between the two classes of materials makes solders not relevant to the claimed invention. Therefore, the fact that solder alloys of the CN Abstract can be formed into solid forms, and that those forms are conventional for solder alloys, does not render obvious the claimed invention because the claimed invention is directed to braze alloys. Moreover, the PL Abstract provides a brazing powder, and the evidence submitted demonstrates that many compositions with its scope cannot be formed into the claimed

solid components, and that compositions within a narrow critical range, i.e., the claimed range, can attain such formability. Thus, the evidence refutes the Examiner's position of obviousness.

Appellants have demonstrated by a preponderance of the evidence that the PL Abstract is inoperable and does not teach or suggest how to make and use the claimed invention as recited in claim 1, and further, that the PL Abstract in combination with the CN Abstract do not present a finite and small, easily traversed number of options that would be obvious to the skilled artisan. Further, Appellants have demonstrated criticality and synergism for the narrow claimed ranges and refuted Examiners position that the claimed solid component forms of the possible alloys disclosed in the broad and questionable teachings of the PL Abstract are obvious in view of the CN abstract, which discloses a solder composition that does not face the same problems with formability as a brazing alloy, at least in part due to the presence of elements that are precluded by the claimed transitional phrase "consisting essentially of." Thus, claim 1 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(2) Claim 5

For at least the same reasons as presented above for claim 1, it is asserted that claim 5 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 1 as falling within the scope thereof, Examples 9A and 11B fall outside the scope of claim 5. The various examples, both within the claimed range and outside the scope of the claimed range, provide ample evidence of the affect of compositional variation on the temperature profile of the alloy. Alloys that fall within the PL Abstract teachings but that fall outside the scope of the temperature limitations in claim 5 include Alloys B, C-1, G, and H-1. It cannot be presumed that the prior art inherently achieves the claimed temperature limitations, and the evidence shows that the temperature limitations are not necessarily achieved. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a particular temperature profile, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 5 is patentable over the PL Abstract in view of the CN Abstract.

(3) Claim 6

For at least the same reasons as presented above for claims 1 and 5, it is asserted that claim 6 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 5 as falling within the scope thereof, Examples F, 5A, 10B, 13B and 15B-17B fall outside the scope of claim 6. As set forth in the paragraph spanning pages 8-9 of the specification, Ni addition in combination with Sn achieves a lowering of the solidus temperature, an increase in hardness and an improvement in corrosion resistance, but too much Ni negatively impacts formability, such that 5-8% Ni provides a balance between corrosion properties and extrudability for forming the claimed solid components. Examples 4A, 6A, 7A, and 8A demonstrate that the temperature profiles remain ideal as Ni content is varied from 5 to 6 to 7 to 8% respectively. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a particular temperature profile, formability and corrosion resistance, of the synergistic relationship between Ni and Sn, of the affect of nickel on formability and corrosion resistance, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 6 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(4) Claim 7

For at least the same reasons as presented above for claims 1, 5 and 6, it is asserted that claim 7 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 6 as falling within the scope thereof, only Examples 6A and 10A fall within the scope of claim 7. As this evidence shows, it cannot be assumed that the composition recited in the PL Abstract will display a major thermal arrest below 1250°F. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a major thermal arrest, nor do they recognize that brazing will occur at or near the major thermal arrest temperature if one is present. As the ample evidence shows, not all alloys within the scope of the prior art or the scope of the claims exhibit major thermal arrests, and those that do, may exhibit a major thermal arrest at a higher temperature. The present application provides guidance to those of ordinary skill in the art that adjustments to the composition can be made to achieve a major thermal arrest and to lower that

thermal arrest temperature to below 1250°F thereby allowing brazing at low temperatures. Reasonable experimentation can achieve the result, but it is certainly not inherent across the broad compositional teachings of the PL Abstract and CN Abstract, and therefore not obvious in view thereof. For these additional reasons, it is asserted that claim 7 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(5) Claim 43

For at least the same reasons as presented above for claim 1, it is asserted that claim 43 is patentable over the PL Abstract in view of the CN Abstract. Additionally, neither the PL Abstract nor the CN Abstract teach or suggest the proviso where the combination of Sn and Sb content does not exceed about 10%. In fact, the PL Abstract teaches an upper limit for Sn of 25% and an upper limit of Sb of 13%. Thus PL Abstract suggests that either of the two elements alone may well exceed the proviso limitation, and cannot reasonably be asserted to teach the limitation on the content of the combination of the two elements being at or below about 10%. Nothing in the CN Abstract provides the skilled artisan with a motivation to pursue that route. It is noted that of the Examples cited with respect to claim 1 as falling within the scope thereof, Example F falls outside the scope of claim 43 due to the sum of the Sn and Sb content exceeding the ~10% limit. As set forth above, Alloy F could not be extruded into wire or rod form and could not be used to form a reliable braze due to the excessive Sn/Sb content. Neither the PL Abstract nor the CN Abstract teach or suggest the proviso, and the evidence rebuts any presumed obviousness. For these additional reasons, it is asserted that claim 43 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(6) Claim 22

Independent claim 22 differs from claim 1 in that, in claim 1, Ag is a required element but Si is optional, whereas in claim 22 Si is a required element but Ag is optional. The specification and evidence submitted herein includes numerous examples of alloys of the present invention set forth in claim 22 and their properties and benefits that support the non-obviousness of the claimed invention. Specifically, referring to previously submitted Table A, the following Examples fall within the scope of claim 22: Alloys F, 4A, 6A, 7A, 8A, 9A, 10A, 11A, 2B, 3B, 5B, 6B, 7B, 8B, 10B, 11B, 13B, 15B, 16B and 17B. Of these 20 examples, only 1 example, Alloy F, was considered to be inoperable for producing a commercially viable braze. As explained above, the reason for the failure of Alloy F was that, despite compliance with the

ranges recited in claim 22, the combined Sn and Sb content exceeds 10%, which is taught in the specification to be important. Thus, one skilled in the art, guided by the specification, would be led to exclude Alloy F from the scope of the claim. The remaining 19 examples were all capable of being formed into the claimed solid components, and all demonstrated good temperature profiles for brazing, including a low solidus temperature and small range between the solidus temperature and the major thermal arrest and/or liquidus temperature. For the test samples falling within the scope of claim 22, the range of P was from 5-7; the range of Sn was from 2-8; the range of Ni was from 0.1-8; the range of Ag was from 0-18; the range of Si was from 0.015-0.5; the range of Sb was from 0-3; and the combined Sn/Sb content ranged from 2-11. Thus, operable examples were given throughout the ranges of each component.

All arguments presented above for claim 1 apply equally to claim 22. Appellants have demonstrated by a preponderance of the evidence that the PL Abstract is inoperable and does not teach or suggest how to make and use the claimed invention as recited in claim 22, and further, that the PL Abstract in combination with the CN Abstract do not present a finite and small, easily traversed number of options that would be obvious to the skilled artisan. Further, Appellants have demonstrated criticality and synergism for the narrow claimed ranges and refuted Examiners position that the claimed solid component forms of the possible alloys disclosed in the broad and questionable teachings of the PL Abstract are obvious in view of the CN abstract, which discloses a solder composition that does not face the same problems with formability as a brazing alloy, at least in part due to the presence of elements that are precluded by the claimed transitional phrase "consisting essentially of." Thus, claim 22 should likewise be deemed patentable over the PL Abstract in view of the CN Abstract.

(7) Claim 25

For at least the same reasons as presented above for claim 22, it is asserted that claim 25 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 22 as falling within the scope thereof, Examples F, 2B-3B, 5B-8B, 10B-11B, 13B, and 15B-17B fall outside the scope of claim 25, each having a Ni content of 2% or less. As set forth in the paragraph spanning pages 8-9, Ni addition in combination with Sn achieves a lowering of the solidus temperature, an increase in hardness and an improvement in corrosion resistance, but too much Ni negatively impacts formability, such that 5-8% Ni

provides a balance between corrosion properties and extrudability for forming the claimed solid components. Examples 4A, 6A, 7A, and 8A demonstrate that the temperature profiles remain ideal as Ni content is varied from 5 to 6 to 7 to 8% respectively. Alloy 9A shows that a slight reduction in Si content relative to the composition of Alloy 6A causes an increase in each of the liquidus, solidus, and major thermal arrest temperatures. Eliminating Ag in the Alloy 9A composition gives Alloy 11A in which the major thermal arrest disappears and the liquidus and solidus are brought into equilibrium. Alloy 10A adds back in Ag but in an amount less than Alloy 9A, and increases the P content. These adjustments provide the alloy with a very tight, low temperature profile ideal for brazing at a low temperature. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a particular temperature profile, formability and corrosion resistance, of the synergistic relationship between Ni and Sn, of the affect of nickel on formability and corrosion resistance, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 25 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(8) Claim 44

For at least the same reasons as presented above for claim 22, it is asserted that claim 44 is patentable over the PL Abstract in view of the CN Abstract. Additionally, neither the PL Abstract nor the CN Abstract teach or suggest the proviso where the combination of Sn and Sb content does not exceed about 10%. In fact, the PL Abstract teaches an upper limit for Sn of 25% and an upper limit of Sb of 13%. Thus PL Abstract suggests that either of the two elements alone may well exceed the proviso limitation, and cannot reasonably be asserted to teach the limitation on the content of the combination of the two elements being at or below about 10%. Nothing in the CN Abstract provides the skilled artisan with a motivation to pursue that route. It is noted that of the Examples cited with respect to claim 22 as falling within the scope thereof, Example F falls outside the scope of claim 44 due to the sum of the Sn and Sb content exceeding the ~10% limit. As set forth above, Alloy F could not be extruded into wire or rod form and could not be used to form a reliable braze due to the excessive Sn/Sb content. Neither the PL Abstract nor the CN Abstract teach or suggest the proviso, and the evidence rebuts any presumed

obviousness. For these additional reasons, it is asserted that claim 44 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(9) Claim 35

Independent claim 35 is similar to claim 44 in that Si is a required element, Ag is optional, and the sum of tin and antimony cannot exceed about 10%, but differs in that Ni is an optional element. The specification and evidence submitted herein includes numerous examples of alloys of the present invention and their properties and benefits that support the non-obviousness of the claimed invention. Specifically, referring to previously submitted Table A, the following Examples fall within the scope of claim 35: Alloys I, J, K, 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B, 11B, 13B, 15B, 16B and 17B. The 17 examples were all capable of being formed into the claimed solid components, and all demonstrated good temperature profiles for brazing, including a low solidus temperature and small range between the solidus temperature and the major thermal arrest and/or liquidus temperature. For the test samples falling within the scope of claim 35, the range of P was from 4-10; the range of Sn was from 1-8; the range of Ni was from 0-2; the range of Ag was from 0-18; the range of Si was from 0.02-0.5; the range of Sb was from 0-2; and the combined Sn/Sb content ranged from 1-8. Thus, operable examples were given throughout the ranges of each component.

To show criticality for the P content of 4-10% and Sn content of 0.1-8%, Alloys I and J were provided with all components within the claim range and P content at the endpoints (4%, 10%) of the claimed range, respectively, and Sn content at or near the endpoints (8%, 1%), respectively. As stated in the second affidavit of Robert Henson for Alloy I:

> *The liquidus temperature is a bit high due to the phosphorus content being at the lower end of the desired range, but a thermal arrest is observed. The alloy was able to be extruded into rod form with good flow properties and acceptable run speed, although the resulting rod/wire was brittle. Additional experimentation, including working the wire, may improve the ductility. The braze tests showed good braze performance, including good flow and cap formation. Only a slight, small crack was observed in the bend test. This alloy could potentially be used commercially, if the brittleness after extrusion can be improved, but the run speed may be limited to the lower end of speeds considered suitable for production.*

As stated in the second affidavit of Robert Henson for Alloy J:

> *The brazing temperature range, although narrow, is on the high end for this alloy, demonstrating the effect of having phosphorus near the upper end of the claimed range,*

and tin at the lower end. An improvement in the temperature profile could be obtained by using 9% or less phosphorus and/or using more tin. The rod/wire was also very brittle after extrusion, although a high run speed was possible. During braze testing, the alloy flowed well, but the high phosphorus content limits the capping ability and contributed to a crack forming during the bend test. Again, an improvement would be expected with a lower phosphorus content.

Alloy K was tested to show an exemplary alloy within the scope of claim 35. As stated in the second affidavit of Robert Henson for Alloy K:

> *Good temperature profile—narrow brazing temperature range and low liquidus temperature. Fast run speeds during extrusion and wire was not brittle. During braze tests, the alloy flowed well, formed good caps and smooth brazes, had good penetration, and the braze did not crack during the bend test. Capable of being commercially produced, and no evidence of likelihood of failure in service.*

These alloys together with Alloys 2B-17B establish criticality for the claimed composition ranges, thereby rebutting any position of obviousness.

In addition, the arguments provided above for claims 1, 43, 22, and 44 equally apply to claim 35. Appellants have demonstrated by a preponderance of the evidence that the PL Abstract is inoperable and does not teach or suggest how to make and use the claimed invention as recited in claim 35, and further, that the PL Abstract in combination with the CN Abstract do not present a finite and small, easily traversed number of options that would be obvious to the skilled artisan, and neither the PL Abstract nor the CN Abstract teach or suggest the proviso. Further, Appellants have demonstrated criticality and synergism for the narrow claimed ranges and refuted Examiners position that the claimed solid component forms of the possible alloys disclosed in the broad and questionable teachings of the PL Abstract are obvious in view of the CN abstract, which discloses a solder composition that does not face the same problems with formability as a brazing alloy, at least in part due to the presence of elements that are precluded by the claimed transitional phrase "consisting essentially of." Thus, claim 35 should likewise be deemed patentable over the PL Abstract in view of the CN Abstract.

(10) Claim 36

For at least the same reasons as presented above for claim 35, it is asserted that claim 36 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 35 as falling within the scope thereof, Examples I, J, 2B-

5B, 9B and 11B fall outside the scope of claim 36. The various examples, both within the claimed range and outside the scope of the claimed range provide ample evidence of the affect of compositional variation on the temperature profile of the alloy. Alloys that fall within the PL Abstract teachings but that fall outside the scope of the temperature limitations in claim 36 include Alloys B, C-1, D-1, F, G, and H-1. It cannot be presumed that the prior art inherently achieves the claimed temperature limitations, and the evidence shows that the temperature limitations are not necessarily achieved. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a particular temperature profile, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 36 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(11) Claim 37

For at least the same reasons as presented above for claim 35, it is asserted that claim 37 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 35 as falling within the scope thereof, Examples I, J, and 15B fall outside the scope of claim 37. The various examples, both within the claimed range and outside the scope of the claimed range provide ample evidence of the affect of compositional variation on the temperature profile and workability of the alloy. As set forth in the second affidavit of Robert Henson (quoted above), and by comparison for example of Alloys I, J and K, adjustment of the phosphorus content to the middle of the range, i.e., 6-7%, increases the ductility of the alloy making it suitable for extrusion into the claimed solid wire components and prevents cracking of the braze, as well as creates a very narrow temperature range between the solidus and the liquidus (and/or major thermal arrest). Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve workability of the alloy into solid shaped components and/or a particular temperature profile, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 37 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(12) Claim 38

For at least the same reasons as presented above for claim 37, it is asserted that claim 38 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 37 as falling within the scope thereof, Examples K, 4B-5B, 9B and 16B-17B fall outside the scope of claim 38. The various examples, both within the claimed range and outside the scope of the claimed range provide ample evidence of the affect of compositional variation on the temperature profile and workability of the alloy. As this evidence shows, it cannot be assumed that the composition recited in the PL Abstract will display a major thermal arrest below 1275°F. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a major thermal arrest, nor do they recognize that brazing will occur at or near the major thermal arrest temperature if one is present. As the ample evidence shows, not all alloys within the scope of the prior art or the scope of the claims exhibit major thermal arrests. The present application provides guidance to those of ordinary skill in the art that adjustments to the composition can be made to achieve a major thermal arrest and to lower that thermal arrest temperature to below 1275°F thereby allowing brazing at low temperatures. Reasonable experimentation can achieve the result, but it is certainly not inherent across the broad compositional teachings of the prior art, and therefore not obvious in view of the prior art. For these additional reasons, it is asserted that claim 38 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(13) Claim 39

Independent claim 39 is similar to claim 35 in that Si is a required element, Ag is optional, the sum of tin and antimony cannot exceed 10%, and Ni is an optional element, but differs in that the transitional phrase is "consists of" instead of "consists essentially of" and the solid brazing component is specified to be "fluxless." The specification and evidence submitted herein includes numerous examples of alloys of the present invention and their properties and benefits that support the non-obviousness of the claimed invention. Specifically, referring to previously submitted Table A, the following Examples fall within the scope of claim 39: Alloys I, J, K, 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B, 11B, 13B, 15B, 16B and 17B. The 17 examples were all capable of being formed into the claimed solid components, all were suitable for brazing without the need for adding a flux (i.e., they are self-fluxing), and all demonstrated good temperature profiles for brazing, including a low solidus temperature and small range between

the solidus temperature and the major thermal arrest and/or liquidus temperature. For the test samples falling within the scope of claim 39, the range of P was from 4-10; the range of Sn was from 1-8; the range of Ni was from 0-2; the range of Ag was from 0-18; the range of Si was from 0.02-0.5; the range of Sb was from 0-2; and the combined Sn/Sb content ranged from 1-8. Thus, operable examples were given throughout the ranges of each component.

In addition, the arguments provided above for claims 1, 43, 22, 44, and 35 at least equally apply to claim 39. Appellants have demonstrated by a preponderance of the evidence that the PL Abstract is inoperable and does not teach or suggest how to make and use the claimed invention as recited in claim 39, and further, that the PL Abstract in combination with the CN Abstract do not present a finite and small, easily traversed number of options that would be obvious to the skilled artisan, and neither the PL Abstract nor the CN Abstract teach or suggest the proviso. Further, Appellants have demonstrated criticality and synergism for the narrow claimed ranges and refuted Examiners position that the claimed solid component forms of the possible alloys disclosed in the broad and questionable teachings of the PL Abstract are obvious in view of the CN abstract, which discloses a solder composition that does not face the same problems with formability as a brazing alloy, at least in part due to the presence of elements that are precluded by the claimed transitional phrase "consists of."

Further, Examiners incorrect use of terminology renders the Examiner's position confusing and nonsensical. One cannot eliminate the paste, since that constitutes eliminating both the brazing powder and the carrier. If one eliminates the carrier, such that the brazing alloy remains in powder form instead of paste form, then it is not a solid brazing component as claimed, and furthermore, there is no suggestion in the reference that doing so enables a lowering of the brazing temperature versus the paste form. The evidence previously submitted demonstrated that Alloy A, which corresponds to the specific alloy in the PL Abstract, could not be used for brazing in either paste form or carrier form without destroying the copper parts being brazed, such that with or without the carrier the alloy is inoperable for its intended purpose. It is thus an incorrect position asserted by Examiner that the carrier can simply be eliminated when a lower brazing temperature isn't needed. In addition, the evidence submitted previously shows that many compositions within the scope of the PL Abstract but outside the scope of the claims cannot be formed into claimed solid components, in direct opposition to Examiner's position of combinability of the teachings of the CN Abstract and the PL Abstract.

In addition, the CN Abstract discloses solder compositions (by definition, having a liquidus below 840°F) that contain elements precluded from the scope of the present invention by the transitional phrase "consists of." At best, the CN Abstract would suggest adding these elements to the composition of the PL Abstract, which could increase the malleability/formability but would also create a solder composition (having a liquidus below 840°F), thereby changing the basic character of the alloy of the PL Abstract such that it is no longer a brazing alloy as intended. Combination of references cannot alter the intended use of the alloy of the primary reference. For at least these reasons, it is asserted that claim 39 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(14) Claim 40

For at least the same reasons as presented above for claim 39, it is asserted that claim 40 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 39 as falling within the scope thereof, Examples I, J, 2B-5B, 9B and 11B fall outside the scope of claim 40. The various examples, both within the claimed range and outside the scope of the claimed range provide ample evidence of the affect of compositional variation on the temperature profile of the alloy. Alloys that fall within the PL reference teachings but that fall outside the scope of the temperature limitations in claim 40 include Alloys B, C-1, D-1, F, G, and H-1. It cannot be presumed that the prior art inherently achieves the claimed temperature limitations, and the evidence shows that the temperature limitations are not necessarily achieved. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a particular temperature profile, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 40 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(15) Claim 41

For at least the same reasons as presented above for claim 39, it is asserted that claim 41 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 39 as falling within the scope thereof, Examples I, J, and 15B fall outside the scope of claim 41. The various examples, both within the claimed range and outside the scope of the claimed range provide ample evidence of the affect of compositional

variation on the temperature profile and workability of the alloy. As set forth in the second affidavit of Robert Henson (quoted above), and by comparison for example of Alloys I, J and K, adjustment of the phosphorus content to the middle of the range, i.e., 6-7%, increases the ductility of the alloy making it suitable for extrusion into the claimed solid wire components and prevents cracking of the braze, as well as creates a very narrow temperature range between the solidus and the liquidus (and/or major thermal arrest). Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve workability of the alloy into solid shaped components and/or a particular temperature profile, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 41 should be deemed patentable over the PL Abstract in view of the CN Abstract.

(16) Claim 42

For at least the same reasons as presented above for claim 41, it is asserted that claim 42 is patentable over the PL Abstract in view of the CN Abstract. It is noted that of the Examples cited with respect to claim 41 as falling within the scope thereof, Examples K, 4B-5B, 9B and 16B-17B fall outside the scope of claim 42. The various examples, both within the claimed range and outside the scope of the claimed range provide ample evidence of the affect of compositional variation on the temperature profile and workability of the alloy. As this evidence shows, it cannot be assumed that the composition recited in the PL Abstract will display a major thermal arrest below 1275°F. Neither the PL Abstract nor the CN Abstract provide any teaching or suggestion of adjusting the composition to achieve a major thermal arrest, nor do they recognize that brazing will occur at or near the major thermal arrest temperature if one is present. As the ample evidence shows, not all alloys within the scope of the prior art or the scope of the claims exhibit major thermal arrests. The present application provides guidance to those of ordinary skill in the art that adjustments to the composition can be made to achieve a major thermal arrest and to lower that thermal arrest temperature to below 1275°F thereby allowing brazing at low temperatures. Reasonable experimentation can achieve the result, but it is certainly not inherent across the broad compositional teachings of the prior art, and therefore not obvious in view of the prior art. For these additional reasons, it is asserted that claim 42 should be deemed patentable over the PL Abstract in view of the CN Abstract.

B. Rejection of Claims 39-42 over the PL Abstract in view of Yurasko or Joseph

(1) Claims 39-42

Arguments presented above for claims-39-42 regarding the PL Abstract apply equally to this rejection. Appellants have demonstrated by a preponderance of the evidence that the PL Abstract is inoperable and does not teach or suggest how to make and use the claimed invention as recited in claims 39-42, and further, that the PL Abstract does not present a finite and small, easily traversed number of options that would be obvious to the skilled artisan. Moreover, the PL Abstract does not teach or suggest the proviso. In fact, the PL Abstract teaches an upper limit for Sn of 25% and an upper limit of Sb of 13%, thus suggesting that either of the two elements alone may well exceed the proviso limitation, and cannot reasonably be asserted to teach the limitation on the content of the combination of the two elements being at or below about 10%. Joseph and Yurasko fail to identify Sb as a substitute for Sn, in whole or in part, and cannot then teach or suggest a limit on the content of the two elements in combination. In addition, Yurasko also fails to provide one skilled in the art with any reasoning by which to select a finite and small, easily traversed number of options in accordance with the claimed invention, particularly for the Ni element. Further, Appellants have demonstrated criticality and synergism for the narrow claimed ranges. Joseph or Yurasko fail to provide motivation or reasoning to select particular alloy compositions from the extremely large and unpredictable number of options in the PL Abstract to arrive at the claimed invention. Claims 39-42 are therefore asserted to be non-obvious over the combination of the PL Abstract in view of either Yurasko or Joseph.

The brazing alloys of the invention recited in claims 39-42 are formed into solid components that can be placed adjacent the parts to be joined and which upon the application of heat, such as by a torch flame or a furnace, melt and flow under capillary action into the joints. Flame spraying, as disclosed in Yurasko or Joseph takes a powder alloy or cast rod and feeds it into a flame sprayer, which heats and atomizes the alloy and propels it in atomized form onto the part as a coating. Thus, furnace or torch brazing to form joints between parts is not the same as flame spraying to form a weld coating on a part. The alloys of the invention are not atomized and propelled onto the part, but rather, are heated at the part surface to melt and flow into a joint. That the alloy of Joseph can be cast into a rod and fed as a raw material to a flame sprayer does not teach or suggest that the alloys of the PL Abstract can be formed into the claimed solid

components for a brazing operation to form a joint between parts. Further Yurasko does not teach or suggest anything but a powder raw material for flame spraying to form a weld coating, and requires an additional coating of copper around the alloy particles to enable the coating formation. The combination of references does not teach or suggest a fluxless solid brazing component. For at least these additional reasons, it is asserted that claims 39-42 should be deemed patentable over the PL Abstract in view of either Yurasko or Joseph.

(2) Claim 40

For at least the same reasons as presented above for claim 39, it is asserted that claim 40 is patentable over the PL Abstract in view of either Yurasko or Joseph. Further, the various examples discussed above for claim 40, both within the claimed range and outside the scope of the claimed range, provide ample evidence of the affect of compositional variation on the temperature profile of the alloy. Alloys that fall within the PL reference teachings but that fall outside the scope of the temperature limitations in claim 40 include Alloys B, C-1, D-1, F, G, and H-1. It cannot be presumed that the prior art inherently achieves the claimed temperature limitations, and the evidence shows that the temperature limitations are not necessarily achieved. Neither the PL Abstract nor Yurasko or Joseph provide any teaching or suggestion of adjusting the composition to achieve a particular temperature profile, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 40 should be deemed patentable over the PL Abstract in view of either Yurasko or Joseph.

(3) Claim 41

For at least the same reasons as presented above for claim 39, it is asserted that claim 41 is patentable over the PL Abstract in view of either Yurasko or Joseph. Further, the various examples discussed above for claim 41, both within the claimed range and outside the scope of the claimed range, provide ample evidence of the affect of compositional variation on the temperature profile and workability of the alloy. As set forth in the second affidavit of Robert Henson (quoted above), and by comparison for example of Alloys I, J and K, adjustment of the phosphorus content to the middle of the range, i.e., 6-7%, increases the ductility of the alloy making it suitable for extrusion into the claimed solid wire components and prevents cracking of the braze, as well as creates a very narrow temperature range between the solidus and

the liquidus (and/or major thermal arrest). Neither the PL Abstract nor Yurasko or Joseph provide any teaching or suggestion of adjusting the composition to achieve workability of the alloy into solid shaped components and/or a particular temperature profile, nor do they recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to the copper parts being brazed. For these additional reasons, it is asserted that claim 41 should be deemed patentable over the PL Abstract in view of either Yurasko or Joseph.

(4) Claim 42

For at least the same reasons as presented above for claim 41, it is asserted that claim 42 is patentable over the PL Abstract in view of either Yurasko or Joseph. Further, the various examples discussed above for claim 41, both within the claimed range and outside the scope of the claimed range, provide ample evidence of the affect of compositional variation on the temperature profile and workability of the alloy. As this evidence shows, it cannot be assumed that the composition recited in the PL Abstract will display a major thermal arrest below 1275°F. Neither the PL Abstract nor Yurasko or Joseph provide any teaching or suggestion of adjusting the composition to achieve a major thermal arrest, nor do they recognize that brazing will occur at or near the major thermal arrest temperature if one is present. As the ample evidence shows, not all alloys within the scope of the prior art or the scope of the claims exhibit major thermal arrests. The present application provides guidance to those of ordinary skill in the art that adjustments to the composition can be made to achieve a major thermal arrest and to lower that thermal arrest temperature to below 1275°F thereby allowing brazing at low temperatures. Reasonable experimentation can achieve the result, but it is certainly not inherent across the broad compositional teachings of the prior art, and therefore not obvious in view of the prior art. For these additional reasons, it is asserted that claim 42 should be deemed patentable over the PL Abstract in view of either Yurasko or Joseph.

C. Rejection of Claims 35-42 over EP '861 in view of the CN Abstract

(1) Claims 35-42

As presented above, the CN Abstract is a solder composition, which is not combinable with a brazing composition. There is simply no teaching or suggestion that a brazing alloy of EP '861 can be formed into the specific claimed solid brazing components in view of a

teaching that a solder alloy can be so formed. Again, the malleability/formability of the two distinct types of alloys are different as a result of differences in their compositions, which differences are prohibited by the "consists essentially of" and "consists of" language of claims 35-38 and 39-42, respectively.

Additionally, EP '861 and the CN Abstract each fail to identify Sb as a substitute for Sn, in whole or in part, and cannot then teach or suggest a limit on the content of the two elements in combination. There is no evidence that one skilled in the art, with the combined references before them, would have reason to select the two elements in combination and to limit their combined content to about 10%. There is simply no teaching or suggestion of the proviso that "the sum of tin and antimony does not exceed about 10%" such that claims 35- 42 should be deemed patentable over EP '861 in view of the CN Abstract.

(2) Claims 36, 38, 40, 42

According to MPEP 2112.01, "the prima facie case can be rebutted by evidence showing that the prior art products do not <u>necessarily</u> possess the characteristics of the claimed product." In the event a *prima facie* case of obviousness is deemed to be established, Appellants have shown, by ample evidence, that only certain alloys possess the characteristics of liquidus, solidus and major thermal arrest, thereby rebutting the *prima facie* case. For example, while Alloys I, J, 2B-5B, 9B and 11B fall within the compositional scope of claims 35 and 39, they do not possess a liquidus temperature below 1300°F and a solidus temperature below 1200°F, as recited in claims 36 and 40. And, while Alloys J, K, 4B-5B, 9B and 16B-17B fall within the compositional scope of claims 35 and 39, they do not possess a major thermal arrest below 1275°F, as recited in claims 38 and 42. Indeed, those alloys do not possess any major thermal arrest. Thus, the evidence has demonstrated that the prior art does not <u>necessarily</u> possess the claimed properties/characteristics across its broad compositional teachings. The narrow recitation in the claims together with the teachings in the specification provide to one skilled in the art the means to achieve these characteristics, without undue experimentation, which such teaching is wholly absent in the prior art. Thus, Appellants have rebutted the *prima facie* of obviousness, according to the standard, as expressed in the MPEP and case law, of demonstrating that the claimed properties are not necessarily possessed by the prior art. For these additional reasons, it is asserted that claims 36, 38, 40 and 42 should be deemed patentable over EP '861 in view of the CN Abstract.

D. Rejection of Claims 22, 25, 35-42 and 44 over the SU Abstract or Yurasko in view of the CN Abstract

(1) Claims 22, 25, 35-42 and 44

With respect to the SU Abstract, it is asserted that the In content is prohibited by the transitional phrase "consisting essentially of" in claims 22, 25, 35-38 and 44 and "consists of" in claims 39-42. The In content is strictly precluded by "consists of" in claims 39-42. Further, the reference admits that the addition of the element has an effect on the basic and novel characteristics of the alloy, and thus is precluded by "consisting essentially of" in claims 22, 25, 35-38 and 44. Appellant need not prove that it does not desire that effect or that the opposite effect is desired. Appellant need only establish that the additional element would have an effect on the basic and novel characteristics of the alloy, and that is established by the reference itself, by admission. Examiner is requiring something more than the law requires. Claims 22, 25, 35-42 and 44 are therefore asserted to be non-obvious over the combination of the SU Abstract in view of the CN Abstract.

With respect to Yurasko, each element of the copper base alloys described therein is optional except copper. Nickel has a very broad range of 0-30. No examples of specific alloy compositions are provided. Yurasko is directed to a welding powder, not a solid brazing component, and one skilled in the art cannot possibly glean from Yurasko how a solid brazing component might be formed in view of this broad teaching of a welding powder alloy. Moreover, there is nothing in Yurasko to suggest that the compositions therein are suitable for use at brazing temperatures, i.e., that the compositions have a liquidus temperature above 840°F as claimed. With Yurasko as the starting reference point, there cannot be said to exist a finite number of identified, predictable solutions to which the prior art suggested the universe be limited nor to which a skilled artisan would have been led to achieve based on the knowledge at the time the invention was made. One skilled in the art would have to have some reason to select the particular combinations of alloys from the large number of options presented by Yurasko, and to have a reasonable expectation that such combinations would produce the desired result. In finding obviousness, Examiner has simply retraced the path of the inventor with hindsight, discounted the number and complexity of the alternatives, and ignored the synergy with which the elements of the alloy operate, not to mention assumed temperature properties to be inherently present in the reference when there is no reasonable justification to make such assumptions. The

particular combination of elements determines the temperature characteristics of an alloy, and therefore defines whether an alloy is suitable as a brazing alloy. Moreover, brazing alloy compositions of multiple elements as claimed present an unpredictability in results, and the synergy with which the elements interact contributes to that unpredictability, such that a finite number of options is not present, and there is no reasonable expectation of success in view of Yurasko to select from the myriad of possible options presented therein. These factors apply against a finding of obviousness. Moreover, the combination with the CN Abstract does nothing to lead one skilled in the art down the path of success. Solders are not the same as brazing alloys and the formability of the two are not the same, with brazing alloys being known to those of skill in the art to be more brittle and more difficult to form into solid forms while solders are malleable and easily formed. Each component of an alloy affects its physical properties, and it cannot be assumed that all possible alloy compositions of Yurasko, even if any can be said to be suitable as brazing alloys, can be formed into the claimed solid forms simply because a reference to a solder alloy claims that solders can be so formed. Again, there is no reasonable expectation of success for a finite number of alloys. Examiner has failed to establish a *prima facie* case of obviousness, such that Examiner's rejection should be overturned.

(2) Claims 35-42

With respect to the SU Abstract, it is asserted that the Ni content is prohibited by the transitional phrase "consisting essentially of" in claims 35-38 and "consists of" in claims 39-42. The SU Abstract discloses 8-15% Ni, which is well above the claimed amount of 0-3%. For the claimed range, Alloys 5B-8B demonstrate the effect of even small adjustments to the nickel content between 1-2%. As can be seen in the data, increasing the nickel content from 1% to 2% has little effect on the liquidus, but lowers the solidus temperature and causes a major thermal arrest to occur closer to the solidus temperature thereby decreasing the brazing temperature range. Therefore, the evidence establishes that Ni content has a material effect on the basic and novel characteristics of the alloy, and therefore is precluded by the partially closed transition language, and is strictly precluded by the closed transition language. For these additional reasons, it is asserted that claims 35-42 should be deemed patentable over the SU Abstract in view of the CN Abstract.

With respect to Yurasko, which discloses 0-30% Ni content, the vast majority of the range in the prior art is precluded from the claim scope, as just discussed. One skilled in the

art cannot ascertain from the reference what alloy compositions may be selected from the large number of possibilities in Yurasko that will achieve the desired results of the claimed invention versus which should be precluded. For these additional reasons, it is asserted that claims 35-42 should be deemed patentable over Yurasko in view of the CN Abstract.

(3) Claims 35-42 and 44

In addition, neither the SU Abstract nor Yurasko teach or suggest the proviso in claims 35-42 and 44, which establishes a maximum of 10% Sn + Sb. The SU Abstract discloses that the Sn content alone can be as much as 12%. Neither the SU Abstract nor Yurasko identify Sb as a substitute for Sn, in whole or in part, and therefore cannot then teach or suggest a limit on the content of the two elements in combination. Alloys D-1 (with Ag) and D-2 (without Ag) were tested with 11% Sn to demonstrate the effect of exceeding the 10% limit, and the second affidavit of Robert Henson stated the following for each:

> *Good temperature profile, but the alloy was hard to extrude, and based upon my experience, it would not be practical to extrude this alloy on a commercial basis. In addition, the wire was extremely brittle, and could not be wrapped onto a reel. During the braze tests, the alloy flowed too quickly, such that gaps could not be easily filled and voids were left in the brazed joints of the tube and return bend. These brazed parts would be scrapped upon visual inspection. In addition, the braze cracked in the bend test, such that if the parts were not scrapped, there is a high likelihood of failure in service. Thus, this alloy is not a reliable braze material.*

Neither the SU Abstract nor Yurasko teach the claimed solid brazing components, and the evidence establishes that the SU Abstract includes embodiments that exceed the proviso so as to produce alloys that are not suitable for forming the claimed solid components and that are unsuitable for the intended purpose. Moreover, combination with the CN Abstract is improper, as explained above. The CN Abstract includes elements that fall outside the scope of the claims and that are prohibited thereby, and that contribute to the alloy being a solder composition, not a brazing alloy. The references are not combinable to produce a solid brazing component as recited, and thus, there is no *prima facie* case of obviousness. For these additional reasons, it is asserted that claims 35-42 and 44 should be deemed patentable over the SU Abstract or Yurasko in view of the CN Abstract.

(4) Claims 36, 38, 40 and 42

In the event a *prima facie* case of obviousness is deemed to be established, Appellants have shown, by ample evidence, that only certain alloys possess the characteristics of liquidus, solidus and major thermal arrest, thereby rebutting the *prima facie* case. For example, while Alloys I, J, 2B-5B, 9B and 11B fall within the compositional scope of claims 35 and 39, they do not possess a liquidus temperature below 1300°F and a solidus temperature below 1200°F, as recited in claims 36 and 40. And, while Alloys J, K, 4B-5B, 9B and 16B-17B fall within the compositional scope of claims 35 and 39, they do not possess a major thermal arrest below 1275°F, as recited in claims 38 and 42. Indeed, those alloys do not possess any major thermal arrest. Thus, the evidence has demonstrated that the prior art does not <u>necessarily</u> possess the claimed properties/characteristics across its broad compositional teachings. The narrow recitation in the claims together with the teachings in the specification provide to one skilled in the art the means to achieve these characteristics, without undue experimentation, which such teaching is wholly absent in the prior art. Thus, Appellants have rebutted the *prima facie* of obviousness, according to the standard, as expressed in the MPEP and case law, of demonstrating that the claimed properties are not necessarily possessed by the prior art. For these additional reasons, it is asserted that claims 36, 38, 40 and 42 should be deemed patentable over the SU Abstract or Yurasko in view of the CN Abstract.

E. Rejection of Claims 22, 25, 35-38 and 44 over the CN Abstract

The Chinese Abstract states that the alloys are solders, which <u>by definition</u> have a liquidus temperature below 840°F. The liquidus temperature distinction between solders and brazing alloys is well established in the metallurgical art. Each claim recites a "solid brazing component having a liquidus temperature above 840°F." Because the Chinese Abstract discloses solders, they cannot inherently possess a liquidus temperature above 840°F, <u>by definition</u>. Appellant need not prove basic scientific principles that are known to those of ordinary skill in the art. These are not identical alloys, but rather, they merely have overlapping components. Thus, inherency cannot be assumed, and in this case, it contradicts the basic knowledge and principles in the art. The CN Abstract includes Zr, Ti, Ce and Zn, which affect the basic and novel characteristics of the alloys, and contribute to their status as solders, not brazing alloys. The content of these alloying elements is prohibited by the transitional phrase "consisting

essentially of." Note that the CN Abstract discloses two compositions, the first referred to as a low temperature solder and the second as a middle temperature solder, i.e., a higher temperature alloy than the first. The two alloys contain identical ranges for each of Sn, Zr, Ti, Ni, Ce, and Si. The second (middle temp) differs from the first (low temp) in that the second contains 20-45 % Zn versus 0% Zn in the first, and the second contains 0.02-0.2 P versus 3-10% in the first. Clearly, Zn and P affect the temperature profile of the alloy compositions, and specifically their liquidus temperature, since their alteration changes the alloy from a low temperature solder to a middle temperature solder. The P and Zn contents fall outside the claimed ranges, and it is inherent in the reference that those two alterations in content have a material effect on the basic and novel characteristics of the alloy, and are therefore precluded by the transitional phrase "consisting essentially of." Appellant should not bear a burden of proving what is already inherently true in the reference itself. Further note that the Sn, P, Ni, and Si contents of the first composition (low temp) are either within or overlap the ranges in the claims, yet the first composition is a low temperature solder, thereby having a lower liquidus temperature than the second composition (middle temp) and a lower liquidus temperature than a brazing alloy, which by definition has a higher liquidus than a solder. The elements that differ, and therefore logically must be said to materially affect the temperature profile of the alloy, are Zr, Ti, and Ce. Logic and common sense dictate that it is inherent in the reference that these elements have a material effect on the basic and novel characteristics of the alloy, and are therefore precluded by the transitional phrase "consisting essentially of." That being the case, there is simply no *prima facie* case of obviousness such that claims 22, 25, 35-38 and 44 should be deemed patentable over the CN Abstract.

F. Rejection of Claims 1, 5, 22 and 43 over Joseph

(1) Claims 1, 5, 22 and 43

Joseph does not teach or suggest a solid brazing component. As is known in the art, brazing components are used between two parts to melt and flow into the joint by capillary action to bond the two parts together. Joseph only suggests flame spraying an alloy from a raw material powder or cast rod form, to heat and atomize the raw material and propel it onto a part surface to form a weld coating. This does not amount to a teaching or suggestion of a solid brazing component of the claimed forms. There is thus no *prima facie* case of obviousness of

claims 1, 5, 22, or 43 over Joseph, such that claims 1, 5, 22, or 43 should be deemed patentable over Joseph.

(2) Claim 5

For at least the same reasons as presented above for claim 1, it is asserted that the claim 5 is patentable over Joseph. It is noted that of the Examples cited with respect to claim 1 as falling within the scope thereof, Examples 9A and 11B fall outside the scope of claim 5. The various examples, both within the claimed range and outside the scope of the claimed range, provide ample evidence of the affect of compositional variation on the temperature profile of the alloy. Alloys that fall within Joseph's teachings but that fall outside the scope of the temperature limitations in claim 5 include Alloys 9B and 11B. It cannot be presumed that the prior art inherently achieves the claimed temperature limitations, and the evidence shows that the temperature limitations are not necessarily achieved. Joseph fails to provide any teaching or suggestion of adjusting the composition to achieve a particular temperature profile, and he does not recognize the need for a narrow range between the solidus and liquidus temperatures and the need for a maximum on the liquidus temperature to avoid damage to copper parts being brazed. For these additional reasons, it is asserted that claim 5 is patentable over Joseph.

(3) Claim 43

For at least the same reasons as presented above for claim 1, it is asserted that the claim 43 is patentable over Joseph. Joseph does not teach or suggest the proviso where the combination of Sn and Sb content does not exceed about 10%. In fact, Joseph fails to identify Sb as a substitute for Sn, in whole or in part, and therefore cannot then teach or suggest a limit on the content of the two elements in combination. For these additional reasons, it is asserted that claim 43 is patentable over Joseph.

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Claims Appendix

1. A solid brazing component having a liquidus temperature above 840°F selected from the group consisting of wire, strip, foil and preforms, wherein the brazing component is made of an alloy consisting essentially of, in weight percent:

   (a) about 4-9% phosphorus;

   (b) about 0.1-10% tin;

   (c) about 0.1-15% nickel;

   (d) about 0.1-18% silver;

   (e) up to about 3% silicon;

   (f) up to about 4% antimony;

   (g) up to about 3% manganese; and

the balance copper.

2-4. Canceled

5. The component of claim 1 wherein the brazing component has a liquidus temperature less than about 1410°F and a solidus temperature less than about 1100°F.

6. The component of claim 5 wherein the alloy consists essentially of:

   (b) about 4-8% tin;

   (c) about 5-8% nickel;

   (d) about 1-18% silver; and

about 0.001-0.1% silicon.

7. The component of claim 6 wherein the alloy exhibits a major thermal arrest at a temperature below about 1250°F.

8-21. Canceled

22. A solid brazing component having a liquidus temperature above 840°F selected from the group consisting of wire, strip, foil and preforms, wherein the brazing component is made of an alloy consisting essentially of, in weight percent:

(a) about 4-9% phosphorus;

(b) about 0.1-10% tin;

(c) about 0.1-15% nickel;

(d) up to about 18% silver;

(e) about 0.001-3% silicon;

(f) up to about 4% antimony;

(g) up to about 3% manganese; and

the balance copper.

23-24. Canceled

25. The component of claim 22 wherein the alloy consists essentially of:

(c) about 5-8% nickel.

26-34. Canceled

35. A solid brazing component having a liquidus temperature above 840°F selected from the group consisting of: wire, strip, foil and preforms, wherein the brazing component is made of an alloy consisting essentially of, in weight percent:

(a) about 4-10% phosphorus;

(b) about 0.1-8% tin;

(c) about 0.001-3% silicon;

(d) up to about 3% nickel;

(e) up to about 18% silver;

(f) up to about 4% antimony;

(g) up to about 3% manganese; and

the balance copper, with the proviso that the sum of tin and antimony does not exceed about 10%.

36. The component of claim 35 wherein the brazing component has a liquidus temperature less than about 1300°F and a solidus temperature less than about 1200°F.

37. The component of claim 35 wherein the alloy consists essentially of:

(a) about 6-7% phosphorus;

(b) about 2-8% tin;

(c) about 0.001-1% silicon;

(f) up to about 2% antimony; and

the balance copper.

38. The component of claim 37 wherein the alloy exhibits a major thermal arrest at a temperature below about 1275°F.

39. A fluxless solid brazing component having a liquidus temperature above 840°F selected from the group consisting of: wire, strip, foil and preforms, wherein the brazing component consists of, in weight percent:

(a) about 4-10% phosphorus;

(b) about 0.1-8% tin;

(c) about 0.001-3% silicon;

(d) up to about 3% nickel;

(e) up to about 18% silver;

(f) up to about 4% antimony;

(g) up to about 3% manganese; and

the balance copper, with the proviso that the sum of tin and antimony does not exceed about 10%.

40. The component of claim 39 wherein the brazing component has a liquidus temperature less than about 1300°F and a solidus temperature less than about 1200°F.

41. The component of claim 39 wherein the brazing component consists of:

(a) about 6-7% phosphorus;

(b) about 2-8% tin;

(c) about 0.001-0.1% silicon;

(f) up to about 2% antimony; and

the balance copper.

42. The component of claim 41 wherein the alloy exhibits a major thermal arrest at a temperature below about 1275°F.

43. The component of claim 1 with the proviso that the sum of tin and antimony does not exceed about 10%.

44. The component of claim 22 with the proviso that the sum of tin and antimony does not exceed about 10%.

Evidence Appendix

The following is evidence submitted and relied upon by the Appellant and entered by the Examiner. For each of the 5 identified submissions of evidence below, the corresponding page numbers of this Appendix are identified.

Evidence Entered	Examiner Acknowledged
Affidavit of Linda Morgan under 37 C.F.R. § 1.132 ¶ 1 submitted as part of Supplemental Response to Final Office Action filed 8/31/05 (2 pp). Pages 45-46 herein.	Declaration acknowledged on page 7 of Non-final Office Action dated 10/25/05.
First Affidavit of Robert Henson under 37 C.F.R. § 1.132 ¶ 1 submitted as part of Supplemental Response to Final Office Action filed 8/31/05, consisting of a 5 page Affidavit, 7 page Exhibit of pictures, and 1 page Table 1. Pages 47-61 herein.	Declaration acknowledged on page 7 of Non-final Office Action dated 10/25/05.
Second Affidavit of Robert Henson under 37 C.F.R. § 1.132 ¶ 1 submitted as part of Supplemental Response to Final Office Action filed 8/31/05, consisting of a 9 page Affidavit, and a 100 page Exhibit for each Alloy A, B, C-1, C-2, D-1, D-2, E, F, G, H-1, H-2, I, J, and K including a Table, Chart, and R&D Run with pictures. Pages 62-171 herein.	Declaration acknowledged on page 7 of Non-final Office Action dated 10/25/05.
Third Affidavit of Robert Henson under 37 C.F.R. § 1.132 ¶ 1 submitted as part of Response to Office Action filed 2/27/06, consisting of a 4 page Affidavit, 3 page Table A, and 8 page Exhibit of pictures. Pages 172-186 herein.	Declaration acknowledged on page 6 of Final Office Action dated 5/18/06.
Fourth Affidavit of Robert Henson under 37 C.F.R. § 1.132 ¶ 1 submitted as part of Response to Final Office Action filed 8/18/06 and as a submission with the Request for Continued Examination filed 10/17/06, consisting of a 3 page Affidavit. Pages 187-189 herein.	Declaration acknowledged on page 2 of the Advisory Action dated 9/15/06 and on page 6 of Non-final Office Action dated 6/28/07.

* It is noted that the filing procedures of the PTO are such that colored photographs submitted as evidence are converted to black and white, and therefore, may not show the Board the testing results as clearly as if the integrity of the colored photographs were maintained. Should the Board desire to see the evidence in color, Appellant will gladly re-submit the evidence in a manner suggested by the Board immediately upon request.